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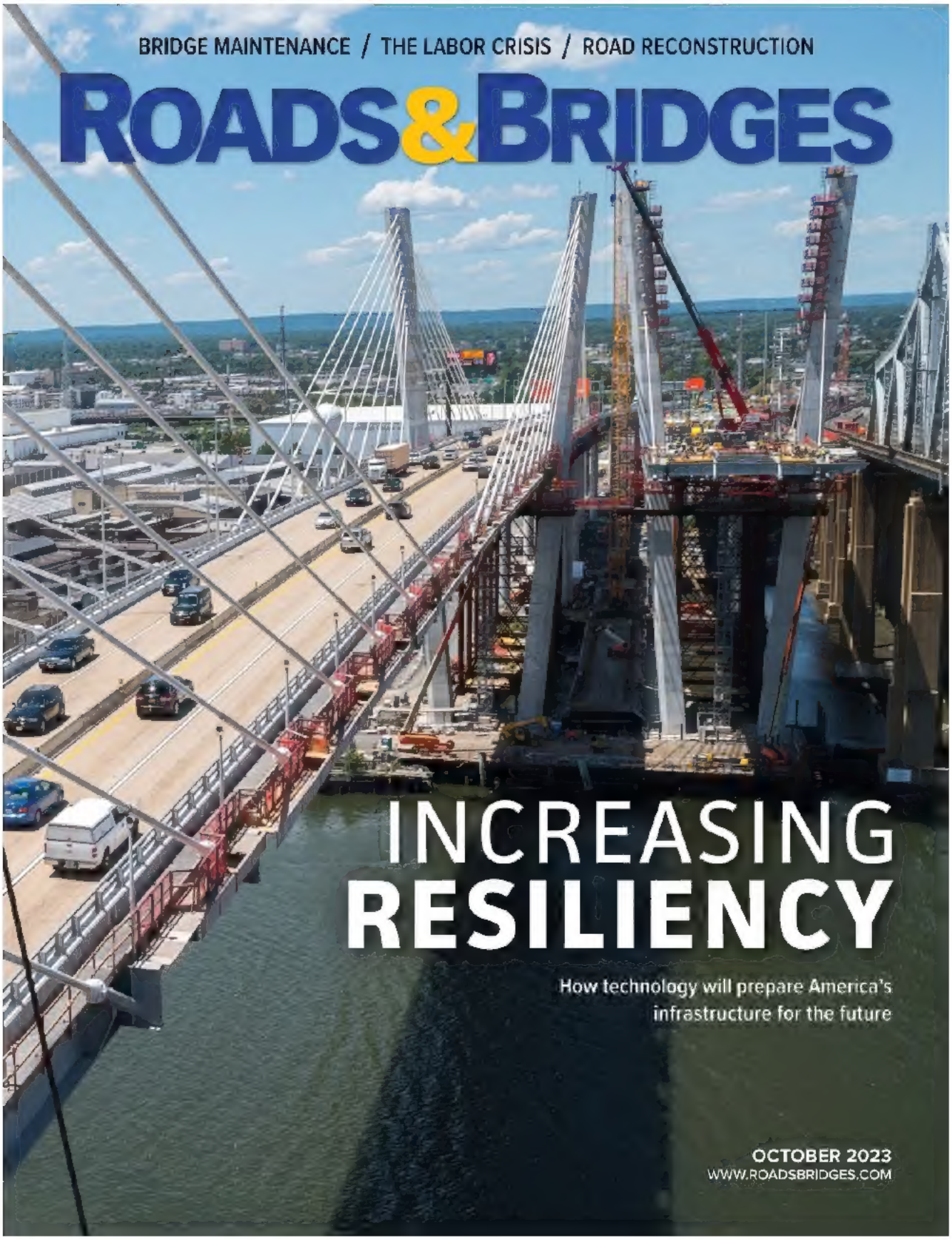

INCREASING RESILIENCY

How technology will prepare America's infrastructure for the future

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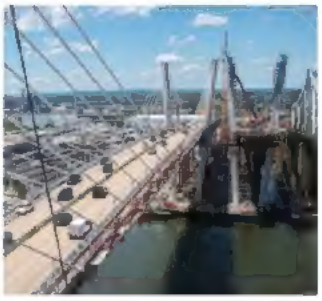

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The Goethals Bridge between New York and New Jersey.
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Proceed With Caution

AI can help our industry, but it needs regulated

▶ **WATCH ONE MOVIE,** I beg you.

That's a popular saying on Twitter, which is now called X because Elon Musk, who lost billions of dollars when he bought the social media platform, thinks (incorrectly) that it's a better name.

People usually post those words in a quote tweet — which is a tweet of a tweet, or an X of X, if that's what they're called now — and the original tweet often links to an article that outlines something new that artificial intelligence (AI) can do that could lead to human extinction.

The point behind, "Watch one movie, I beg you," is that America's tech and political leaders in Silicon Valley and Washington, D.C., need to consider negative consequences of AI (like they failed to do with social media).

"Watch one movie, I beg you," insinuates that we are headed toward human extinction at the hands of AI and if leaders would just watch "The Terminator" or "Ex Machina," maybe it would knock some sense into them.

Our leaders might actually be taking the threat seriously. In June, tech leaders from across the globe who specialize in AI signed an open letter warning that it could destroy humanity. And, in September, Congress held hearings on AI. Lawmakers from each political party, who rarely agree on anything, said there is universal agreement that AI needs regulated.

However, I am dubious that America's politicians are on top of this. First, they love money, and tech leaders who don't want regulated have lots of that. Second, politicians aren't known for speed and competence. Third, the hearings featured Musk and Mark Zuckerberg, who runs a social media platform that went from objectifying women to threatening democracy in about a decade.

Recently, these billionaires discussed fighting each other. You know, normal adult behavior that warrants trust when talking about serious topics.

In this issue, we have an interesting opinion piece from Andy Tryba, the CEO of Gigster, a software development company. Tryba outlines ways AI can help the roads and bridges construction industry.

Tryba and I also recorded an episode of Infastructure Insider Interviews, where we discuss AI. He's optimistic about AI and confident it will help our industry thrive.

I'm confident I'll be one of the first to die when "The Terminator" becomes reality.

Maybe I'm a crazy luddite, but I fear that companies will give AI systems increasing autonomy until AI is connected to vital infrastructure, like power grids or military weapons. Then: Boom!

We need guardrails. And, I don't trust tech leaders or politicians.

Experts say that where we are with AI wasn't possible two years ago.

AI has progressed so rapidly that I want tech leaders to watch on loop the scene in "Jurassic Park," where Jeff Goldblum's character says, "Your scientists were so preoccupied with whether they could, they didn't stop to think if they should." R&B

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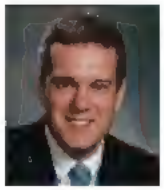

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Confusing Waters

A Supreme Court ruling leaves room for ambiguity

▶ **WHAT HAPPENS WHEN** there may be a "significant nexus" between "adjacent" and/or "relatively permanent" "Waters of the United States" (WOTUS)?

Answer: Confusion, uncertainty, ambiguity, great consternation, and litigation leading to an opinion by the highest court in the land.

It is not often that the U.S. Supreme Court (USSC) decides something impacting the construction industry, so I could not resist writing about this one: Sackett v. EPA, No. 21-454. The Supreme Court's opinion is long and full of history, as most USSC opinions are, but this column attempts to share the most important parts.

In 2004, the Sacketts were (and may still be) owners of a residential property in Idaho. They were backfilling the lot with dirt to prepare for building a house when the Environmental Protection Agency (EPA) informed them that their property included wetlands, and the backfilling operation violated the Clean Water Act (CWA) because it was occurring near a ditch that fed into a nearby creek.

Negligent discharge of pollutants can result in criminal penalties including imprisonment. Civil penalties can be "crushing consequences" for negligent acts and worse for willful violations.

The CWA prohibits discharging pollutants into WOTUS. The EPA decided the ditch and nearby creek were part of the WOTUS and ordered the owners to restore the site or pay fines of over $40,000 per day.

At that time, the EPA interpreted WOTUS to include "[a]ll . . . waters" that "could affect interstate or foreign commerce," and "[w]etlands adjacent" to WOTUS. "Adjacent" meant not just "bordering" or "contiguous, but also neighboring." Even the non-navigable creek that fed into a lake nearby the owner's property was a WOTUS entirely within Idaho that the EPA deemed traditionally navigable.

Taken to its logical extreme, permits could be required for roadside ditches or even puddles that are regularly wet.

On May 25, the USSC decided the EPA exceeded its authority. In its decision, the USSC stated that "the CWA extends only to those 'wetlands with a continuous surface connection to bodies that are 'waters of the United States' in their own right,' so that they are indistinguishable from those waters."

The USSC further stated, the term "waters" in the CWA means only "geographic[al] features that are described in ordinary parlance as 'streams, oceans, rivers, and lakes'" and to adjacent wetlands that are "indistinguishable" from those bodies of water due to a continuous surface connection.

Despite this ruling, the USSC also said, "[t]he meaning of [WOTUS] under the EPA's interpretation remains 'hopelessly indeterminate.'"

The USSC did not eviscerate the CWA. The Supreme Court acknowledged the CWA (since its enactment in 1972) has done much good to clean-up "formerly fetid bodies of water." Indeed, the "CWA is a potent weapon."

Negligent discharge of pollutants can result in criminal penalties including imprisonment. Civil penalties can be "crushing consequences" for negligent acts and worse for willful violations.

On Sept. 8, the EPA and U.S. Army Corps of Engineers published a new version of the rule that narrows the scope of WOTUS and attempts to address some of the USSC's findings of uncertainty in the old rule.

Nevertheless, the latest rule still includes several ambiguities.

WOTUS now includes traditional navigable waters, territorial seas, interstate waters, tributaries of such waters that are "relatively permanent," standing or continuously flowing bodies of water, wetlands having a continuous surface connection to WOTUS, and intrastate lakes, ponds, streams, or wetlands that are "relatively permanent," standing or continuously flowing bodies of water with a continuous surface connection to navigable waters, territorial seas, or interstate waters.

Additional bodies of water may still be regulated by state authorities, but this is the new boundary for federal regulation. The term "adjacent" now means "a continuous surface connection."

However, this latest version of the rule does not define "relatively permanent," which will still require a case-by-case determination by the local Army Corps district. Recordings from EPA and Army Corps informational presentations about the latest rule revisions will be posted to the EPA's website at https://www.EPA.gov/WOTUS. R&B

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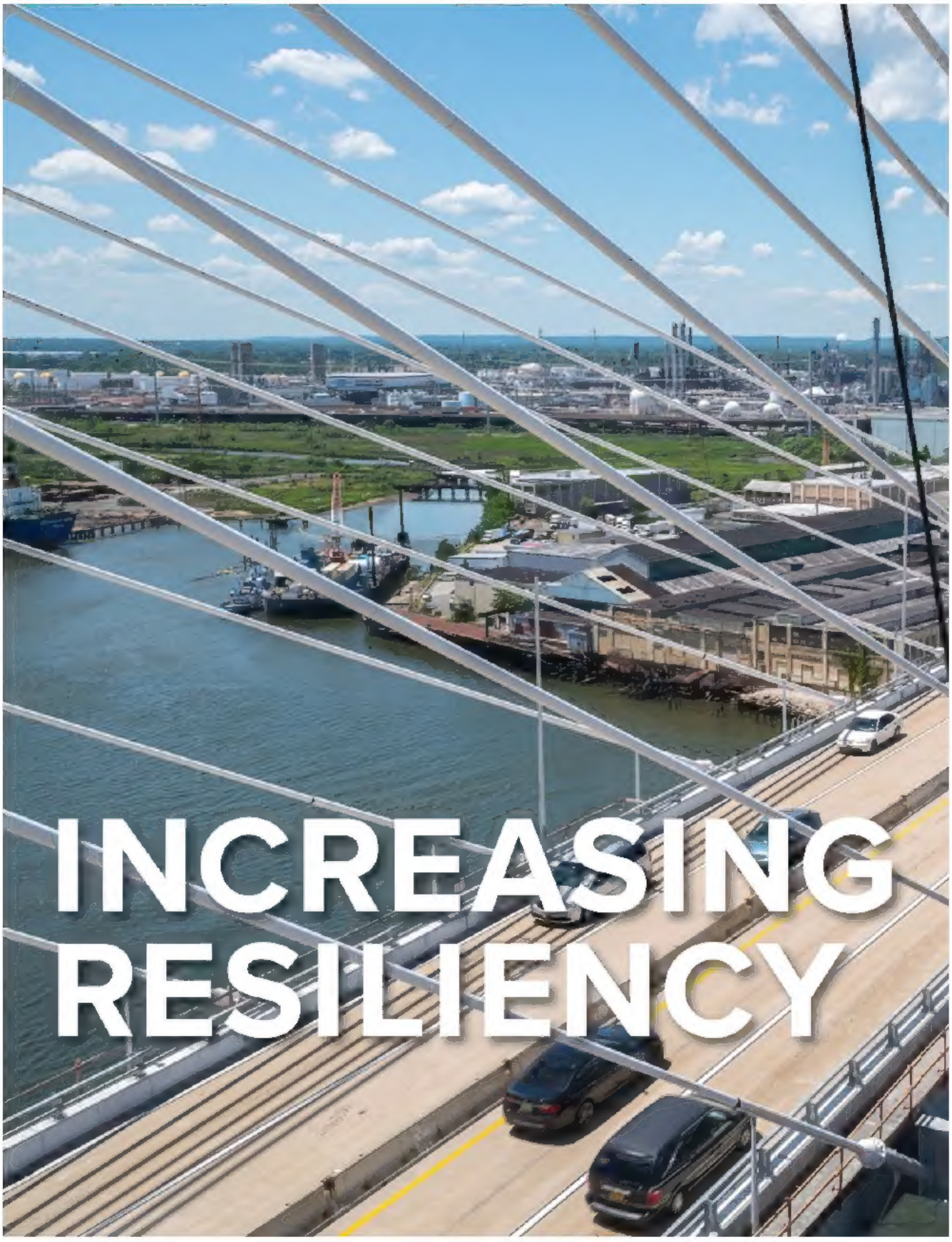
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The Goethals Bridge between New York and New Jersey.
CREDIT: ANDY RYAN/HNTB

WAYS TO PREPARE BRIDGE NETWORKS FOR THE FUTURE | By Erik Zuker, Contributing Author

▶ **IN THE COMING YEARS,** bridges will experience increasing demands due to trends in freight as well as extreme weather driven by climate change. These demands are set against a backdrop of infrastructure deterioration as many bridges reach the end of their intended service lives.

When discussing our nation's bridges, the American Society of Civil Engineers' 2021 Report Card for America's Infrastructure states that, "additional deterioration over the next 50 years will become overwhelming." The report also points out that 42% of bridges are at least 50 years old and more than 45,000 are structurally deficient.

Many agencies have identified vulnerable assets within their transportation networks, but challenges, including budget constraints and environmental complexities, limit their ability to adapt. Technology, however, can enhance a multi-decade repair plan.

Properly applied, technology can help bridge owners safely extend the useful life of structures, gather information to better quantify vulnerabilities, and increase situational awareness to manage risk more effectively. This article will focus on ways existing technology can be leveraged to support these efforts.

THE ROLE OF A RESILIENCE FRAMEWORK

To understand and plan for future challenges, some agencies have developed a resilience framework. The Federal Highway Administration defines resilience as the ability to anticipate, prepare for and adapt to changing conditions and withstand, respond to, and recover rapidly from disruptions.

Vulnerability and resilience assessments at the individual asset level have become commonplace, but a network-wide resiliency analysis is still an area of improvement for most agencies.

Considering resiliency at the network level can bring hidden vulnerabilities to light. For example, it is well understood that major river crossings and signature bridges are key to a transportation network's function. Smaller bridges, however, can play an equally critical role by maintaining a connection to isolated populations or allowing transport to essential facilities during an extreme weather event.

In recent years, key advances in technology have made it easier to collect, process, and analyze information. These advances include low-energy sensors, increases in battery power, wireless technology that make conduit runs unnecessary, increases in cellular bandwidth, and the ubiquity of cloud computing resources to host and post-process large amounts of data.

The combination of these developments reduces the cost and effort required to monitor assets. This means bridge owners have greater access to sensing technology that can support resiliency efforts by quantifying structural behavior and increasing situational awareness during extreme weather events.

TECHNOLOGY TO ENHANCE HYDRAULIC RESILIENCY

In the coming decades, bridges may face significant challenges in escalating hydraulic demands due to increased rainfall intensity driven by climate change. Increased flooding risks could place unprecedented demands on bridges of all types but appears to disproportionately impact smaller structures.

For some agencies, numerous bridges distributed across a wide geography may make it difficult – in the planning and incident response phases – to predict and react to flood risk and high river levels. Increasing the resilience of bridges over water requires a multi-discipline approach from structural engineers, bridge inspectors, hydrologists, risk analysts, meteorologists, and emergency planners, to name a few.

Because the immediate rehabilitation or retrofit of all bridges is not practical, agencies must consider multiple avenues to manage risk. While technology is only a part of the solution, bridge sensors can provide critical information to understand vulnerabilities, quantify demands, and react in near-real-time to extreme weather events.

For a structure with hydraulic vulnerabilities, sensors may include tilt on the substructure and nearby soil, laser displacement to determine absolute position, and gauges to quantify river height, and speed. Weather stations to capture rainfall amounts and high-resolution static cameras also have become increasingly common in monitoring installations.

The combination of these instruments allows owners to build historical data on local river behavior and the structure's response to environmental factors such as temperature, live load, and soil saturation.

Installation of a remote sensor system at a railway overpass.
CREDIT: SENCEIVE

This historical data set can provide critical insight if utilized as part of a refined analysis to quantify a structure's vulnerability and could even inform an agency's future rehabilitation priorities.

During an extreme weather event, the sensors can be leveraged to provide situational awareness. The weather station can provide information on local rainfall while the river gauges can quantify the hydraulic demands. Tiltmeters and laser displacement sensors can determine if structural parameters are within normal limits or if there are potential instabilities.

Finally, a static camera can provide validation of the sensor readings and information on the river overtopping a bridge to allow informed decisions without exposing personnel to extreme weather.

This real-time data in combination can provide an agency with the information it needs to make decisions about the highest priorities for emergency inspectors and even temporary bridge closures.

These sensors are relatively inexpensive to purchase and deploy, allowing risk to be cost-effectively managed on a larger number of bridges. A proper data management plan that considers cybersecurity and quality will further enhance the strategy.

TECHNOLOGY FOR OVERLOADED BRIDGES

In the coming years, trends in trucking and freight also will change the demands on bridges. Several states already have increased their legal weight limits. Developments in e-commerce and supply chain logistics will modify trucking routes.

Additionally, connected freight (truck platoons) may increase demand on some bridges beyond codified loads. All of this is taking place while agencies rely on bridges designed for the trucks of decades past.

Currently, state agencies utilize a comprehensive system to issue permits and safe routing instructions to overweight trucks and assess old and deteriorated structures with load ratings (which determine allowable truck loads).